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THE EFFECT OF GIBBERELLIN AND OTHER BIOLOGICALLY  
ACTIVE SUBSTANCES ON POTATO VIRUSES

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THE EFFECT OF GIBBERELLIIN AND OTHER  
BIOLOGICALLY ACTIVE SUBSTANCES  
ON POTATO VIRUSES

Following is the translation of an article by L. K. Zherebchuk in the Ukrainian-language periodical Mikrobiologichnyy Zhurnal (Microbiology Journal), Vol 25, No. 5, 1963, pages 8-13.]

The action of gibberellin on plants has recently been rather extensively studied; but the chief subjects of investigation have been the physiological 2, morphological 1, and anatomical 3 changes occurring in plants treated with gibberellin. Little very little attention has been paid to the effect of gibberellin on plant viruses.

Gibberellin is well known to have found a definite practical application, especially with potatoes. The effect of treatment of potato tubers on their further growth and yield is being investigated.

Our aim has been to clarify the effect on X, Y, and S virus reproduction and potato yield of gibberellin and other biologically active substances when used to treat potato plants in the phase of complete budding and beginning of flowering.

The experiments were conducted on the Pryyekul's'kyy [Priyekul'skiy] Early variety. Plot area was 30 square meters, repetition was fourfold. Nourishment area was 60 x 60 cm with one plant to a hill. The plants were sprayed in the budding phase with 0.01, 0.005, and 0.0025% solutions of gibberellin, a 0.0025% solution of gibberellin mixed with a 0.02% solution of heteroauxin, a 1% solution of imanin, and a 1:1000 solution of cansatin.

So that the potato plants might better absorb the gibberellin and other agents the plants were sprayed in the morning hours. The sick plants had been previously enumerated and serologically analyzed for X, Y, and S viruses.

Table 1. Extent of Attack of Virus Diseases on Potato Plants (on 21 June 1961)

1) Всього оглянуто і проаналізо- вано рослини	2) Кількість уражених рослин (в %)			3) Кількість рослин (в %), що за серологічними аналізами містять віруси		
	3) зморши- катою мо- зайкою	4) смуга- стою мо- зайкою	5) скручува- нням листя	X	Y	S
765	1,3	8,6	7,5	65,0	35,3	47,2

Legend: (1) Total of examined and analyzed plants;  
 (2) Number of affected plants, in %; (3) Rugose mosaic; (4) Streak mosaic; (5) Leaf roll;  
 (6) Percentage of plants shown by analysis to contain viruses.

The findings in Table 1 show that the number of plants affected with rugose and streak mosaic and leaf roll is not great--1.3-8.6%. Serological analyses on the other hand showed that 35.3-65% of the plants contained viruses X, Y, or S, for the most part in latent form.

From treatment of the potato plants on 22 June 1961 with gibberellin, gibberellin plus heteroauxin, imanin, and cansatin until the leaves began to die in each type of experiment the plants affected with virus diseases were examined every month and serological analyses were made for viruses X, Y, and S in the plants.

The data obtained indicate (Table 2) that the number of potato plants exhibiting viruses X, Y, and S in the variants of the experiment treating the plants with different concentrations of gibberellin and with gibberellin plus heteroauxin increased by the end of the vegetative stage by 0.1-3.1% with respect to external symptoms. The serological analyses of the same viruses, however, showed that the number of plants with the viruses in latent form decreased by 14.1-38.7% compared with the control (Table 2) and by 4.6-19.1% compared with the initial data (Table 1).

**Table 2. Effect of Gibberellin and Other Biologically Active Agents on Virus Diseases Affecting Potatoes**

1) Вид болезни	2) Кількість розсади, уражених (%)						3) Кількість рослин в % з зараженістю вірусів за серологічними методами						3) Кількість рослин в % з зараженістю вірусів за серологічними методами					
	4) зморшкуватою мозаїкою			5) смугастою мозаїкою			6) скручуванням листя			7) X			Y			Y		
	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII	5.VII	5.VIII
6) Розсада зернами, обприскана 1000 мг/л фуні бутонізаций (андроль)	2,4	3,2	8,6	10,2	10,1	11,0	74,0	81,0	39,3	41,6	53,1	73,5						
7) 0,01% -на розчином гіббереліну	1,3	4,4	8,6	9,7	9,1	10,6	65,4	56,3	27,5	27,5	48,0	36,2						
8) 0,005% -на розчином гіббереліну	1,3	4,2	8,6	9,8	10,0	11,0	60,2	58,0	28,3	24,8	49,0	39,8						
9) 0,0025% -на розчином гіббереліну	1,4	4,4	8,7	9,9	10,4	11,0	60,4	60,0	23,4	20,2	49,0	31,8						
10) 0,0025% -на розчином гіббереліну + 0,02% -на розчином гідроакуміну	1,1	4,1	8,6	8,7	9,8	9,8	60,2	60,4	21,5	20,4	48,1	39,1						
11) 0,02% -на розчином гіббереліну	4,3	4,3	9,1	9,6	10,0	10,5	60,4	60,4	26,4	29,7	48,1	48,3						
12) 1% -на розчином інаміну	4,3	4,4	8,7	8,9	10,2	10,2	69,0	69,8	27,5	32,3	45,3	45,3						
13) розчином інаміну 1:1000	2,4	4,6	8,8	11,4	11,2	11,9	72,0	80,0	28,1	41,6	59,9	67,4						

*Note: See legend on next page/*

Table 2. Legend:

(1) Experimental variant; (2) Percentage of plants affected; (3) Percentage of plants shown by serological analyses to have viruses; (4) Rugose mosaic; (5) Streak mosaic; (6) Potato plants sprayed with water during budding phase (control); (6a) Leaf roll; (7) 0.01% gibberellin solution; (8) 0.005% gibberellin solution; (9) 0.0025% gibberellin solution; (10) 0.0025% gibberellin solution plus 0.02% heteroauxin solution; (11) 0.02% heteroauxin solution; (12) 1% imanin solution; (13) 1:1000 cansatin solution.

When the potato plants were sprayed with a 1% imanin solution, the number of plants with symptoms of rugose mosaic had not increased by the end of the vegetative period, while those with symptoms of streak mosaic and leaf roll had increased by 0.3-2.7% in comparison with the control.

It should be noted that the cansatin solution exerted no effect on the reproduction of viruses, the number of affected plants proving to be the same as in the control. Similar findings also resulted from the serological analyses for X, Y, and S viruses.

We simultaneously studied the effect on potato tuber yield exerted by treating the plants with gibberellin and other biologically active substances (Table 3).

Table 3. Effect of Gibberellin and Other Biologically Active Substances on Potato Tuber Yield (on 26 August 1961)

1) Варіанти досліду	2) Середня вага бульб варіанта (в кг)	3) Середня вага бульб під однією рослиною (в кг)	4) Урожай бульб в переважанку на ц/га	5) Прирівняння урожаю	
	6) в ц/га	7) в %			
8) Рослини картоплі, обприскані водою (контроль) . . . . .	67,2	0,7	194,4	—	—
9) 0,01%-ним розчином гібереліну . . . . .	67,5	0,702	195,0	0,6	0,4
10) 0,005%-ним розчином гібереліну . . . . .	74,7	0,778	215,58	19,8	10,9
11) 0,0025%-ним розчином гібереліну . . . . .	71,5	0,744	206,13	11,73	6,0
12) 0,0025%-ним розчином гібереліну + 0,02% -ним розчином гетероауксіну . . . . .	76,7	0,798	221,14	26,74	13,7
14) 0,02% -ним розчином гетероауксіну . . . . .	71,5	0,744	206,13	11,73	6,0
15) 1%-ним розчином іманіну . . . . .	69,7	0,726	201,12	6,72	3,4
16) розчином кансатину 1:1000 . . . . .	69,9	0,728	201,56	7,16	3,68

Legend: (1) Experimental variant; (2) Average weight of tubers of variant, kg; (3) Average weight of tubers under one plant, kg; (4) Tuber yield in 100 kg per hectare; (5) Increase in yield; (6) In 100 kg per hectare; (7) In percent (8) Potato plants sprayed with; (9) Water (control); (10) 0.01% gibberellin solution; (11) 0.005% gibberellin solution; (12) 0.0025% gibberellin solution; (13) 0.0025% gibberellin solution plus 0.02% heteroauxin solution; (14) 0.02% heteroauxin solution; (15) 1% imanin solution; (16) 1:1000 cansatin solution.

Table 4. Aftereffect of Gibberellin and Other Biologically Active Substances on Virus Diseases Affecting Potatoes (on 7 July 1963)

1) Варіанти досліду	2) Кількість рослин (в %), уражених			3) Кількість рослин (в %) з наявністю вірусу за серологічними аналізами		
	4) змішаною мозаїкою	5) смугастою мозаїкою	6) скручуванням листя	X	Y	S
7) рослини картоплі в 1961 р. в фазі бутонізації, обприскани водою (контроль) . . . . .	0,7	7,4	2,1	90,0	45,0	74,0
8) 0,01%-ним розчином гібереліну . . . . .	—	0,6	1,2	53,0	23,0	25,0
9) 0,005%-ним розчином гібереліну . . . . .	—	1,2	1,3	56,0	20,0	40,0
10) 0,0025%-ним розчином гібереліну . . . . .	—	0,6	1,5	42,0	20,0	39,0
11) 0,0025%-ним розчином гібереліну + 0,02%-ним розчином гетероауксіну . . . . .	—	0,7	1,0	56,0	19,0	40,0
12) 0,02%-ним розчином гетероауксіну . . . . .	—	0,9	1,6	56,0	29,0	42,0
13) 1:6-ним розчином іманіну . . . . .	—	0,1	0,9	58,0	10,0	42,0
14) розчином канкатину 1:1000 . . . . .	—	4,1	0,6	84,0	62,0	66

Legend: (1) Experimental variant; (2) Percentage of affected plants; (3) Percentage of plants shown to have viruses by serological analyses; (4) Rugose mosaic; (5) Streak mosaic; (6) Leaf roll; (7) Potato plants sprayed when budding in 1961 with; (There is no No. 8 - Translator); (9)-(16) Same as in Table 3.

Table 5. Aftereffect of Gibberellin and Other Biologically Active Substances on Phases of Development of Potato Plants, Tuber Yield, and Starchiness Thereof.

1) Варіант досліду	2) відм		3) Бутонізація		4) Цвітіння		7) Стадії	8) Кількість	9) Прибавка врожаю	10) % кро- ків до контролю
	5)	6)	5)	6)	5)	6)		на 100	на 100	
14) Розчини картоплі в 1961 р. у фазі бутонізації, обприсканим водою (контроль) .	15.V	30.V	15.VI	24.VI	27.VI	3.VII	270	1.056	292.8	-
15) 0.01% -ним розчином гібереліну . . . . .	5.V	20.V	9.VI	17.VI	19.VI	27.VI	270	1.057	292.9	-
16) 0.005% -ним розчином гібереліну . . . . .	10.V	30.V	9.VI	17.VI	19.VI	27.VI	274	1.071	297.4	4.4
17) 0.0025% -ним розчином гібереліну . . . . .	10.V	30.V	9.VI	17.VI	19.VI	26.VI	279	1.09	302.7	9.7
18) 0.0025% -ним розчином гібереліну + 0.02% -ним розчином гетероауксину . . . . .	5.V	20.V	9.VI	17.VI	19.VI	27.VI	294	1.150	319.3	26.3
19) 0.02% -ним розчином гетероауксину . . . . .	10.V	30.V	11.VI	19.VI	21.VI	28.VI	270	1.057	292.9	-
20) 1% -ним розчином Іманіну . . . . .	10.V	30.V	11.VI	19.VI	21.VI	27.VI	263	1.03	285	7.5
21) розчином канстатину 1:1000 .	10.V	30.V	15.VI	21.VI	27.VI	3.VII	269	1.051	291.8	-
										13.59

Legend: (1) Experimental variant; (2) Sprouting; (3) Budding; (4) Flowering; (5) Beginning of tuberization; (6) Large scale; (7) Average yield per variant, kg; (8) Yield in 100 kg per hectare; (9) Increase in yield; (10) In percent; (11) In percent; (12) In percent; (13) In percent; (14)-(22) Same as (7) and (11)-(13) in Table 4, respectively.

Spraying the potato plants with a 0.0025-0.005% gibberellin solution, as well as with gibberellin plus heteroauxin, increases the tuber yield by from 11.73 to 26.7 units of 100 kg per hectare.

Increasing the concentration of the gibberellin solution to 0.01% does not affect the potato yield.

The effectiveness of the other substances tested was less than that of gibberellin.

We further studied the aftereffects of treating the budding plants (1961) with gibberellin, heteroauxin, and the other biologically active agents on the resistance of the potatoes grown from their tubers to the viruses of rugose mosaic, as well as on the productivity of the next year (1962). The experiment was set up in accordance with the same system as in 1961.

It turned out that the substances under investigation affected, to some degree or other, the development of the next year's potato plants. In the variants where the plants were treated with gibberellin (100 mg/l, 25 mg/l) and gibberellin plus 200 mg/l of heteroauxin the sprouts appeared 5 to 10 days sooner than in the control. The number of plants affected with X, Y, and S viruses according to the findings of the serological analyses diminished by 15-49% compared to the control (Table 4) and by 7.2-23% compared with the initial data (Table 1).

The number of plants affected with rugose mosaic and leaf roll was insignificant--from 0.1 to 1.6% against 2.1 to 7.4% in the control.

It was discovered that the yield of the tubers and their starchiness varied sharply according to the experimental variant (Table 5). The offspring of the plants treated in 1961 with 0.01% gibberellin solution, 0.02% heteroauxin solution, and cansatin gave a harvest similar to that from the control. The offspring of the plants treated with 0.0025% gibberellin solution gave a tuber harvest higher by 440-960 kg per hectare than the control.

A particularly great difference in the tuber harvest was observed in the offspring of the 1961 plants treated with the mixture of 0.0025% gibberellin and 0.02% heteroauxin solutions (263 kg per hectare greater).

When the gibberellin concentration in the potato spray rose from 25 to 100 mg/l the starch content of the tubers increased from 0.73 to 2.1% (Table 5).

#### Conclusions:

~~+~~ Treatment of potato plants in the budding stage with a solution of gibberellin, in particular gibberellin mixed with heteroauxin, retards

the spread of virus infections. On the basis of serological analyses it was established that the number of plants affected with the viruses of rugose mosaic had not increased by the end of the vegetative period.

4. Gibberellin in a concentration of 25-100 mg/l, as well as gibberellin mixed with heterauxin, is good prophylaxis against potato viruses and favors the increase in tuber yield and starch content during the year in which it is used and also has the same aftereffect.

5. The other biologically active substances tested had a certain negative effect on the viruses, but did not influence the productivity of the potatoes.

6. The preparation cansatin exerted no effect on the virus or the potato yield. ( ) ↑

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